

# User Manual with Augmented Reality to Support Packaging Products

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**Abstract** — Indonesia is a furniture product exporter. Shipping of furniture products becomes a matter because of the large space needed for each product, causing expensive delivery cost. Transactions with costumers from other regions, or even other countries are obstructed, as a consequence.

KUBE mainan anak (kid toys) at Jurangombo district, South Magelang, which produces kid toys such as wooden tipping horse, experiences the same problem.

This problem can actually be solved by applying knock-down model packaging, by which products are aparted into smaller pieces, to be reassembled later by users/ costumers,. In order to make delivery of products more efficient, many furniture companies already apply this kind of model, make the products into being easy to sell in supermarket, and costumers can directly purchase the product. But another problem yet emerge then for some costumers/ product users to re-assembly the product since they hard to understand the product manual-book attached.

Augmented Reality technology being used to add virtual object into real environment perception, where users interact within virtual form. Problem statement in this research is 'how to make user manual model which can display kid toys assembling-process with augmented reality, with horse tipping toy as object or study case. Literature study and experiments become the prime method. Having completed observation and problem statement, next step is design making and system building, comprise 3D animation model and augmented reality technology, to be tested then.

Model being used is horse tipping-toy, redesigned with knocked-down model. Product consist of head, saddle and mattress,thus 7 (seven) assembling-animation are needed. Autodesk 3Ds Max is involved in the making of assembling-process animation. Model produced are transformed into VRML (Virtual Reality Modelling Language) afterwards and being integrated to Augmented Reality then, by using AR Toolkit.

To test whether the Augmented Reality works or not, , we need marker as a trigger to display 3D object. Marker model being employed here is resulted from previous research,which is marker pattern with bold black box. Each marker pattern has to be different, so markers need to be tested until the assembling-animation match the assembling-steps. System testing performed in conditioned laboratory, using a set of computer, webcam, and other supporting tools. In real environment, system trial performed with laptop, randomly,by applying system that is altered into portable in a cd.

The test result shows that augmented reality technology is capable of displaying animation of a product (horse tipping in this case) re-assembling-process by directing marker to a webcam. Animation of toy assembling-process appear in monitor matches the marker directed. The minimu size of the marker to be succeed in displaying horse tipping-toy animation is 3x3 cm,

and will be optimum in 5x5 cm size. Real environment tests show that laptop hardware insignificantly affects the system loading-time compared to security system of laptop operation system. Room lighting condition also affects virtual object visibility in Augmented Reality Technology.

Augmented reality systems within User's guide CD which can display the process of the horse tipping assembling on the laptop's monitor screen, when the webcam is directed to the marker, according to its stages. The most optimal marker size is 5 x 5 cm. user manual System is strongly influenced by the room lighting condition and the operating system is more influential to loading time system than the laptop hardware. The model can be developed to guide other type of knocked- down product.

**Key words** *Packaging, Knock-down, Augmented Reality, Marker, User Manual.*

## I. INTRODUCTION

Indonesia furniture export value reached 1,7 billion USD in 2013, and increased by 1,24% (as much as 626,5 million US Dollar) in the period of january-april 2014, compared to the same period of 2013 <sup>[1]</sup>. But behind that growing number, furniture industrialists actually experience problem in shipping of their products to other regions or countries, related to the large space needed in furniture packaging, which cause expensive delivery cost.

Some furniture manufacturer such as olimpic and ligna, with sales value reached 4,235 billion rupiah in 2008<sup>[2]</sup>, has applied knock-down model in their packaging, by which products are separated into smaller parts, to be reassembled later.

KUBE kid toys centre, located at Jurangombo district in Magelang city, has approximately 32 kid wooden toy-industrialist. Those wooden toys are processed from industrial waste around Magelang city. Object of this research is limited to horse tipping- toy industry. Demand from outside of Magelang city for this product is quite significant,

but transaction often failed caused by the expensive delivery cost.

A furniture product packaging into a knock-down good will increase content quantity, with the result that delivery process more efficient. But costumers/ users of a knock-down product have to re-assemble the product before it is utilized. At this point just problem emerge, as the manual book-attached can confused some consumers in practising the process of re-assembling.

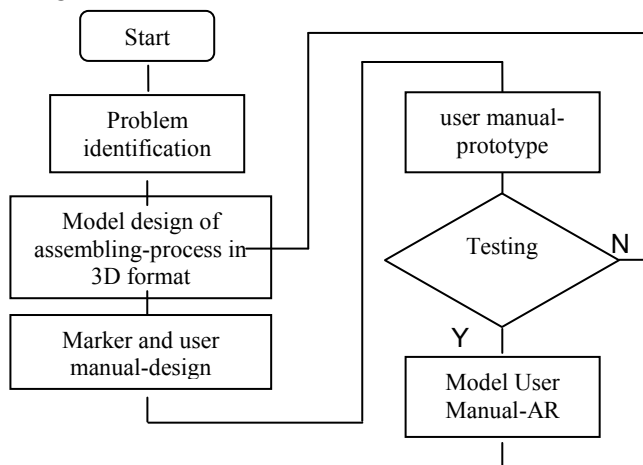
To cope with afore mentioned problems thus a technology or model consuct by which furniture buyers are helped to re-assemble the furniture they bought without having to call a carpenter. That technology should be massively produced with relatively low cost in packaging.

Augmented Reality (AR) technology enables an assembling process-animation of a product, so that the process become easier. When consumers/ users are going to re-assemble the product, simply direct the manual book to laptop camera and animation of assembling process will show up.

## II. MATERIALS AND METHODS

According to Professor Ronald T. Azuma, "Augmented Reality (AR) is refers to a situation in which the goal is to supplement a user's perception of the real-world through the addition of virtual objects". Briefly concluded, AR technology being used to add virtual object into real object of user perception. AR helps real environment surround us to interact in virtual form [3].

This research will comeout with a model design of user manual, by performing literature review and laboratory experiment research method, as shown in figure 1.



Finish

Figure 1. Research Framework

Marker, as a trigger for assembling-animation display, have to be included in user manual. This research used marker model by Afissunani, A., Saleh, A., Assidiqi, M.A. (2011) [4]. Size of the marker used in this research is 5x5 cm as this is the most optimal marker size (based on research outcome conducted by Aman, M., Widiyanto, A. (2013) [5]

Testing performed in conditioned laboratory in order to make the system worked as been planed and suited result estimation. Furthermore is public testing with different condition and more varied hardware, using sample that is suited common people situation. This stage is conducted to repair system to be working in unpredicted conditions.

## III. RESULTS AND DISCUSSION

Object model used here is horse tipping-toy in 3D model, in pieces of toy parts along with **moor-bolt** set up design to merge those pieces. Model is separated into 3 (three) main parts, that are head, body, and base as shown in figure 2.

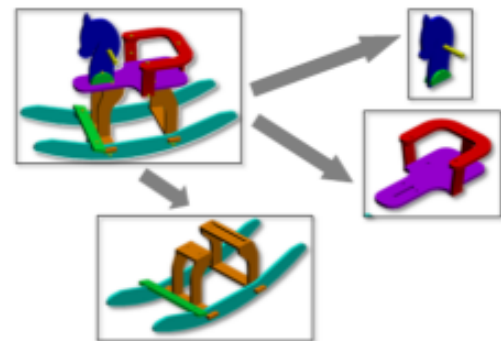


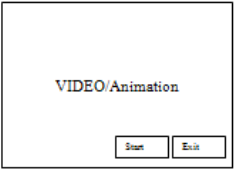
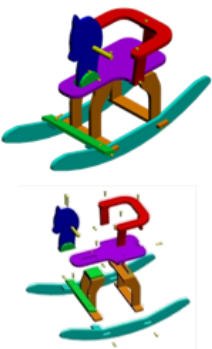
Figure 2. Knock-down Design

As three parts exist, assembling-animation needed then are:

1. Head-assembling
2. Body-assembling, consist of saddle, back-pole, and back part
3. Base-assembling, consist of foot-assembling, foot and base connection
4. Finishing, which connect head and body part.

AR system design is manifested in storyboard to design path of system to be made, as shown in table 1.

TABEL 1. STORYBOARD USER MANUAL WITH AR SYSTEM

No	Pages / Scene	Design	File Name	Explanation
1.	intro (scene 1)	VIDEO/Animation 	intro.mp4/ intro.gif/intro.swf	Video with general instruction of how-to run the system.
2.	assembly (Scene 2-end)		start.wrl kepala.wrl kaki.wrl dudukan.wrl tiang.wrl sandaran.wrl alas_badan.wrl finish.wrl	Number of assembling animation-appears as many as marker within user manual

Next, that model design is made into 3D digital assembling- model animation by Autodesk 3ds Max. AR technology uses VRML language thus the model animation ought to be exported into \*.wrl format, integrated with AR Toolkit program then.

Marker testing at laboratory intended to enactive marker ability in triggering the display of assembling animation at various marker size as shown in figure 3, with result as in table 2.



Figure 3. Marker size-testing

TABEL 2. TESTING OF MARKER SIZE

No	Marker Size (Cm)	Object Show	Explanation
1.	2 x 2	No	No object appeared
2.	3 x 3	Yes, imperfect	Part of object disappeared
3.	4 x 4	Yes, imperfect	Object disappeared when marker moved
4.	5 x 5	Ya, 3 object looked perfect	All object appeared although marker were moved
5.	6 x 6	Ya, 3 object looked less perfect	Object size was bigger, looked less perfect

1.	2 x 2	No	No object appeared
2.	3 x 3	Occasionally	Object appeared, when marker moved object disappeared.
3.	4 x 4	Ya	Object size, when marker rotated object still exist and rotated also
4.	5 x 5	Ya	Bigger object, which rotated in line with marker
5.	6 x 6	Ya	Object size bigger than before, object rotated in line with marker

Table of marker size testing shows that marker size will effect the size of virtual object display, and objects are constantly showing at marker size bigger than 3x3 cm.

Horse tipping-toy assembling needs at least 6 animation thus it needs more than 1 (one) marker. Marker size need also to be tested with multi marker, with the same room condition and marker position to enactive no double object display and no mistake in assembling animation-display



Gambar 4. Pengujian multi marker

Resut of the test shows that the most optimal marker size is 5x5 cm as indicated in table 3.

TABEL 3. TESTING OF MULTI MARKER SIZE

No	Marker Size (Cm)	Object Show	Explanation
1.	2 x 2	No	No object appered
2.	3 x 3	Yes, imperfect	Part of object disappeared
3.	4 x 4	Yes, imperfect	Object disappeared when marker moved
4.	5 x 5	Ya, 3 object looked perfect	All object appeared although marker were moved
5.	6 x 6	Ya, 3 object looked less perfect	Object size was bigger, looked less perfect

Test of animation texture, by changing the size and resolution of the texture, also been performed to minimize system failure of working at any computers or laptop. The test result shown in table 4.

TABLE 4. RESOLUTION &amp; SIZE OF TEXTURE TESTING

No	Resolution /Size	Loading Time	Total File Size
1.	<b>Original</b>	<b>00:00:18 12</b>	<b>62,689 kB</b>
2.	1024 x 768	00:00:15 91	84,856 kB
3.	800 x 600	00:00:15 44	15,700 kB
4.	640 x 480	00:00:15 40	14,336 kB
5.	448 x 336	00:00:15 38	13,324 kB
6.	<b>100% (ori.)</b>	<b>00:00:18 12</b>	<b>62,689 kB</b>
7.	80%	00:00:16 18	42,190 kB
8.	60%	00:00:15 03	30,215 kB
9.	40%	00:00:14 85	30,422 kB
10.	20%	00:00:14 06	17,577 kB

Table 4 shows the smaller file size the faster loading time., but the quality of detail animation display declined as a consequence.

The last testing is transformation of system into portable format (CD) to be tested with laptop, with random sampling of available CD. Result shown in table 5.

TABEL 5. REAL ENVIRONMENT TESTING

No	Specifications	Loading Time	Explanation
1.	Win 8.1 Professional 32 bit AMD C-50 1.00GHz RAM 2 GB	00:00:44 32	Normally influenced by lighting room
2.	Win 7 Ultimate 32 bit Core i3 M350 2,27 GHz	00:00:16 77	Normally influenced by lighting room
3.	Win Ultimate 32 bit Celeron 887 1,5 Ghz RAM 2 GB	00:00:27 22	Normally influenced by lighting room
4.	Win 7 Ultimate 64 bit Celeron 1005M 1,9 GHz RAM 2 GB	00:00:13 53	Normally influenced by lighting room
5.	Win 8.1 Professional 64 bit Core i3 M380 2,53 GHz RAM 4 GB	00:00:13 67	Normally influenced by lighting room
6.	Win 7 Professional 32 bit AMD E1-2100 1,0 GHz RAM 2GB	00:00:48 09	Normally influenced by lighting room
7.	Win 8.1 Professional 64 bit Core 2 Duo T6600 2,2 GHz RAM 4GB	00:00:18 94	Normally influenced by lighting room
8.	Win XP Professional 32bit SP 3 Celeron 1007U 1,5 GHz RAM 1 GB	00:00:16 82	Normally influenced by lighting room

Test in real environment shows that user manual system with AR works normally but it influenced by lighting room (indoor or outdoor), whilst operation system influent more than laptop hardware.

#### IV. CONCLUSION

Augmented reality systems within User's guide CD can display the process of the horse tipping-toy assembling on the laptop's monitor screen, when the webcam is directed to the marker, according to its stages. The most optimal marker size is 5 x 5 cm. user manual System is strongly influenced by the

room lighting condition whilst the operating system influent system loading-time more than the laptop hardware. The model can be developed to guide other type of knocked- down product.

#### V. ACKNOWLEDGMENT

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